Stoller
Hanford Office

DOE-EM/GJ655-2004

299-E25-5 (A6025)
Log Data Report

Borehole Information:

Borehole:	299-E25-5 (A6025)		Site:	216-A-8 Crib	
Coordinates (WA State Plane)		GWL (ft)[1]:	262.35	GWL Date:	4/12/2004
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
136,184.94 m	575,618.24 m	May 1956	202.231 m	293	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	+2.05	6 5/8	6 1/8	1/4	+2.05	230
Welded steel	0	8	unknown	unknown		293

The logging engineer measured the casing stickup using a steel tape. A caliper was used to determine the outside casing diameter. The caliper and inside casing diameter were measured using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated. There is no evidence of 8-in. casing at the ground surface as reported in Ledgerwood (1993).

Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements by Stoller field personnel, HWIS[3], and Ledgerwood (1993). Zero reference is the top of the 6-in. casing.

Logging Equipment Information:

Logging System:	Gamma 1G		Type: 35% HPGe (34TP10967A)
Calibration Date:	01/2004	Calibration Reference:	GJO-2004-597-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 1C		Type: High Rate Detector (39A314)
Calibration Date:	02/07/02	Calibration Reference:	GJO-2003-429-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5
Date	4/12/04	4/12/04	4/12/04	4/14/04	4/15/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	97.0	32.0	21.0	261.0	164.0
Finish Depth (ft)	33.0	21.0	2.0	163.0	96.0
Count Time (sec)	200	20	200	200	200
Live/Real	R	R	R	R	R

Log Run	1	2	3	4	5
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A[4]	N/A	N/A	N/A	N/A
Pre-Verification	AG067CAB	AG067CAB	AG067CAB	AG068CAB	AG069CAB
Start File	AG067000	AG067065	AG067077	AG068000	AG069000
Finish File	AG067064	AG067076	AG067096	AG068098	AG069068
Post-Verification	AG067CAA	AG067CAA	AG067CAA	AG068CAA	AG069CAA
Depth Return Error (in.)	N/A	N/A	+1	-1	N/A
Comments	No fine-gain adjustment.	High rate zone. Dead time > 40%. Count time change.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.

Log Run	6 / Repeat				
Date	4/15/04				
Logging Engineer	Spatz				
Start Depth (ft)	78.0				
Finish Depth (ft)	52.0				
Count Time (sec)	200				
Live/Real	R				
Shield (Y/N)	N/A				
MSA Interval (ft)	1.0				
ft/min	N/A				
Pre-Verification	AG069CAB				
Start File	AG069069				
Finish File	AG069095				
Post-Verification	AG069CAA				
Depth Return Error (in.)	-1				
Comments	Repeat section.				

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2	3	4 / Repeat	
Date	4/16/04	4/16/04	4/16/04	4/16/04	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	34.0	29.0	22.0	26.0	
Finish Depth (ft)	30.0	23.0	21.0	23.0	
Count Time (sec)	300	100	300	100	
Live/Real	R	R	R	R	
Shield (Y/N)	none	none	none	none	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	N/A	
Pre-Verification	AC098CAB	AC098CAB	AC098CAB	AC098CAB	
Start File	AC098000	AC098005	AC098012	AC098014	
Finish File	AC098004	AC098011	AC098013	AC098016	
Post-Verification	AC098CAA	AC098CAA	AC098CAA	AC098CAA	
Depth Return Error (in.)	N/A	N/A	N/A	0	

Log Run	1	2	3	4 / Repeat	
Comments	No fine-gain adjustment.	None	None	Repeat section.	

Logging Operation Notes:

Zero reference was top of the 6-in. casing. Logging was performed without the centralizer on the sonde for spectral data collected between 261 and 163 ft. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118. HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ^{137}Cs verifier with serial number 1013.

Analysis Notes:

Analyst:	Sobczyk	Date:	04/21/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. All of the post-run verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 3.4 percent lower and 4.7 percent higher at the end of the day.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G1GJan04.xls [SGLS] and G1CApr03.xls [HRLS]), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 6-in. casing. Based on Ledgerwood (1993), the casing configuration was assumed to be a string of 6-in. casing with a thickness of 1/4 in. to a log depth of 232 ft and a string of 8-in. casing with a thickness of 0.322 in. to total logging depth (261 ft). The logging engineer measured the 6-in. casing thickness. A casing thickness of 0.322 in. was assumed for the 8-in. casing. This thickness is the published value for ASTM schedule-40 steel pipe, a commonly used casing material at Hanford. Where more than one casing exists at a depth, the casing correction is additive (e.g., the correction for both 6-in. and 8-in. casing would be 0.25 + 0.322 = 0.572). A water correction was not required.

Using the SGLS, dead time greater than 40 percent were encountered in the interval from 22 to 33 ft, and data from this region were considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. SGLS dead time corrections are applied when dead time is greater than 10 percent. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. In addition, a comparison log plot of ^{137}Cs is provided to compare the data collected in 1990 and 1995 by Westinghouse Hanford Company's Radionuclide Logging System (RLS) with SGLS data. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with

counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in three intervals. ^{137}Cs was detected from near the ground surface to a log depth of 6 ft. The range of concentrations was from the MDL (0.3 pCi/g) to 12.8 pCi/g. ^{137}Cs was detected at log depths between 20 and 53 ft. The range of concentrations was from 0.4 to 30,800 pCi/g, which was measured at 25 ft. ^{137}Cs was detected at log depths between 232 and 259 ft. The range of concentrations was from near the MDL to 0.8 pCi/g, which was measured at 232 ft. ^{137}Cs was also detected at 207 and 221 ft at concentrations near the MDL. The well construction summary (Ledgerwood 1993) reported 6-in. casing to 232 ft, with grout to 232 ft. The presence of grout in the annular space between the two casing strings is not accounted for, and likely contributes to underestimation of radionuclides above 232 ft. Spectral data below 232 ft are believed to more accurately represent the contaminated profile.

The concentrations of the KUT and man-made radionuclides above 232 ft are under estimated due to effects of grout.

The behavior of the ^{238}U log suggests that radon may be present inside the borehole casing. Determination of ^{238}U is based on measurement of gamma activity at 609 and/or 1764 keV associated with ^{214}Bi, under the assumption of secular equilibrium in the decay chain. However, ^{214}Bi is also a short-term daughter of ^{222}Rn. When radon is present, ^{214}Bi will tend to "plate" onto the casing wall and will quickly reach equilibrium with ^{222}Rn. Because the additional ^{214}Bi resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are not attenuated.) This effect is observed on 4/12/04 (97 to 2 ft). The effects of radon appear to be minimal in log runs 5 (164 to 96 ft) and 6 (78 to 52 ft). The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Radon daughters such as ^{214}Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with ^{214}Bi and ^{214}Pb.

The presence of radon is not an indication of man-made contamination: it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides (1461, 1764, and 2614 keV), and ^{137}Cs for both the SGLS and HRLS.

Gross gamma logs from Additon et al. (1977) (attached) indicate that the sediments surrounding this borehole contained significant amounts of man-made gamma radiation from 1958 through at least 1976. The logs from 1958, 1959, and 1963 indicate gamma-emitting contamination at or near groundwater. The log from 2/19/58 appears to detect relatively high gamma activity in the intervals from 13 ft (4 m) to total depth. The log from 5/14/63 appears to detect relatively high gamma activity in the interval from 16 ft (5 m) to 128 ft (39 m). The log from 4/30/76 appears to detect relatively high gamma activity in the interval from 16 ft (5 m) to 39 ft (12 m). Comparison of these gross gamma logs indicates that a contamination event occurred prior to 1958. The SGLS detected ^{137}Cs in only two intervals (20 to 53 ft and 232 to 259 ft), while the entire length of the borehole below 16 ft had elevated gamma in the late 1950s.

A comparison log plot of ^{137}Cs data collected in 1990 and 1995 by Westinghouse Hanford Company (WHC) and in 2004 by Stoller is included. The WHC concentration data for ^{137}Cs are decayed to the date of the SGLS logging event in April 2004. Because both the 1990 and 1995 data corrected for only one string

of casing (0.33 in. and 0.26 in., respectively), the ^{137}Cs concentrations based on the SGLS data were recalculated for this comparison using a casing thickness of 0.33 in. The apparent ^{137}Cs concentrations show good agreement between the logging systems above 230 ft. Since 1990, ^{137}Cs activities have decreased as predicted by radioactive decay in the interval above 230 ft. Data suggest an incursion of ^{137}Cs between 1990 and 1995 in the interval from 230 to 260 ft.

References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Well*s, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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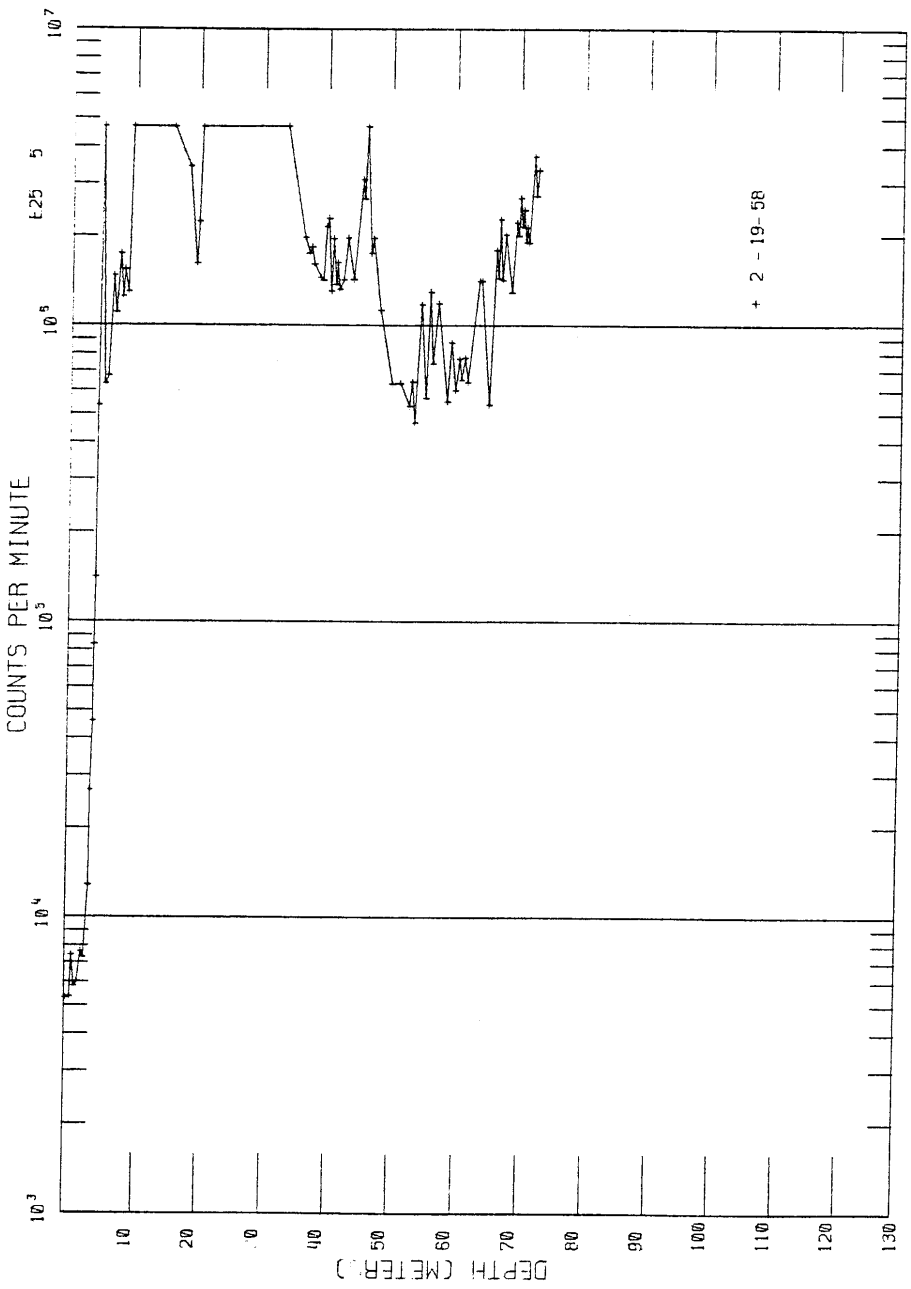
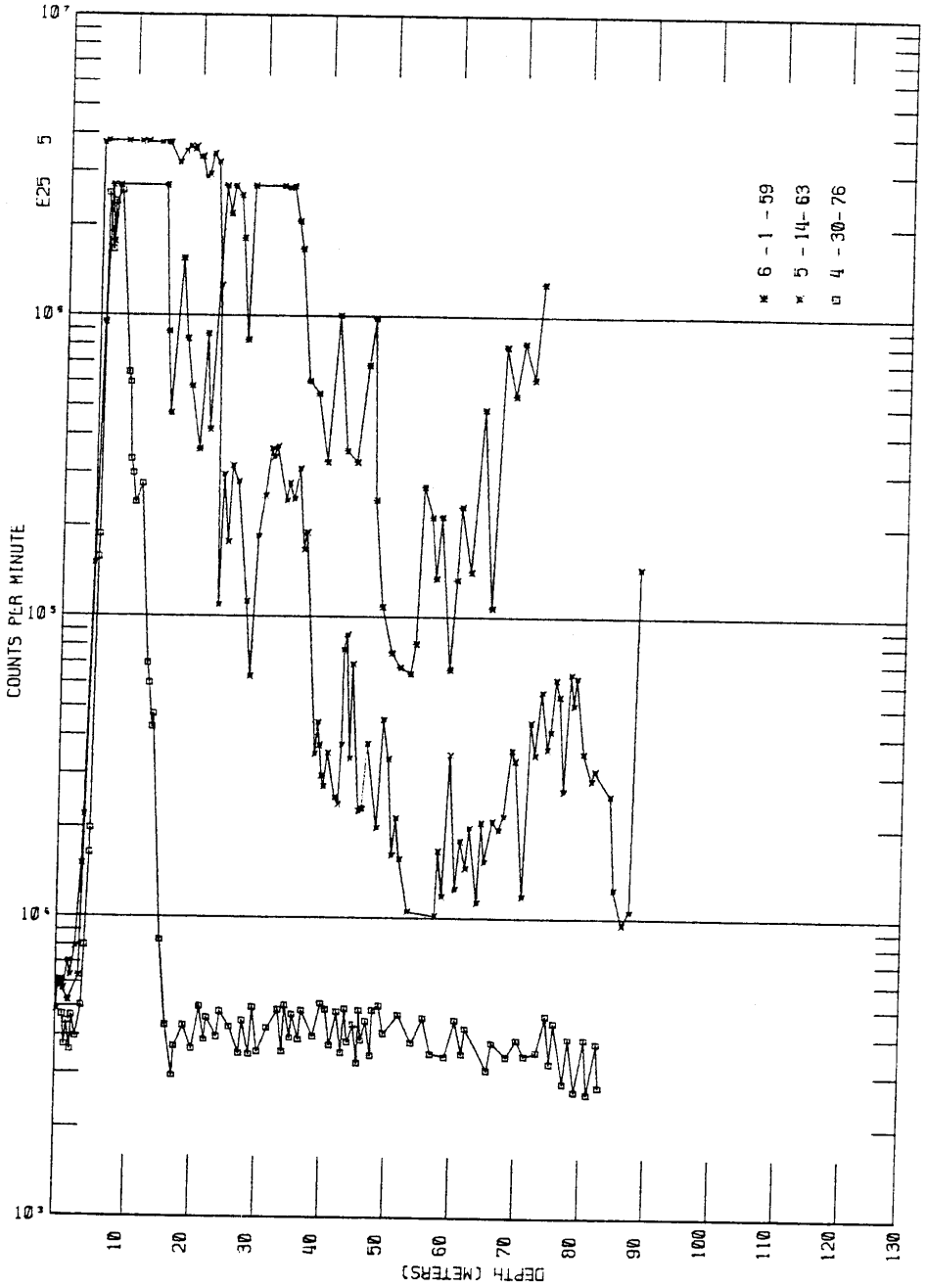
[1] GWL – groundwater level
[2] TOC – top of casing
[3] HWIS – Hanford Well Information System
[4] N/A – not applicable



from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E25-5, Logged on 2/19/58

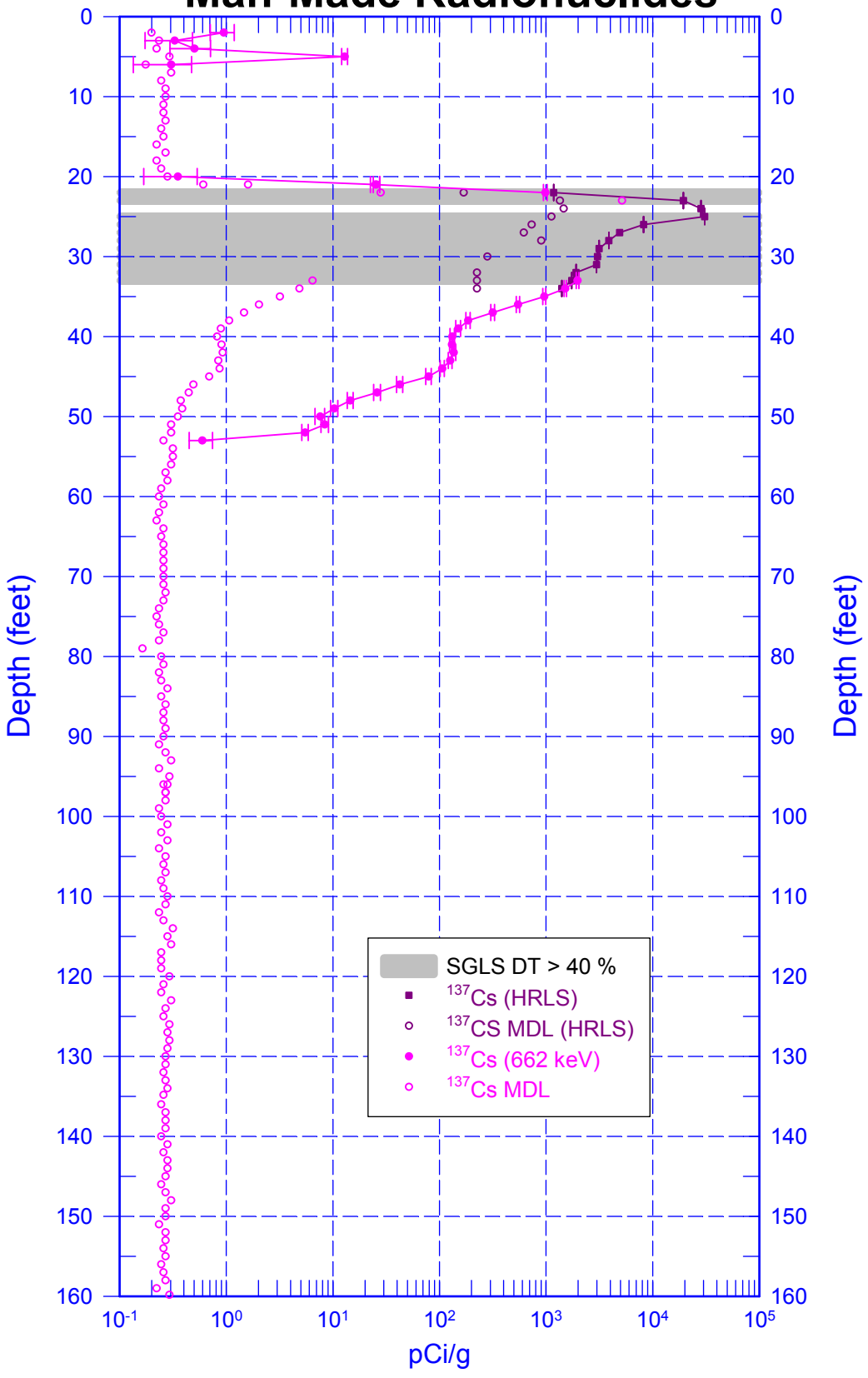


from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E25-5, Logged on 6/1/59, 5/14/63, and 4/30/76

299-E25-5 (A6025)

Man-Made Radionuclides

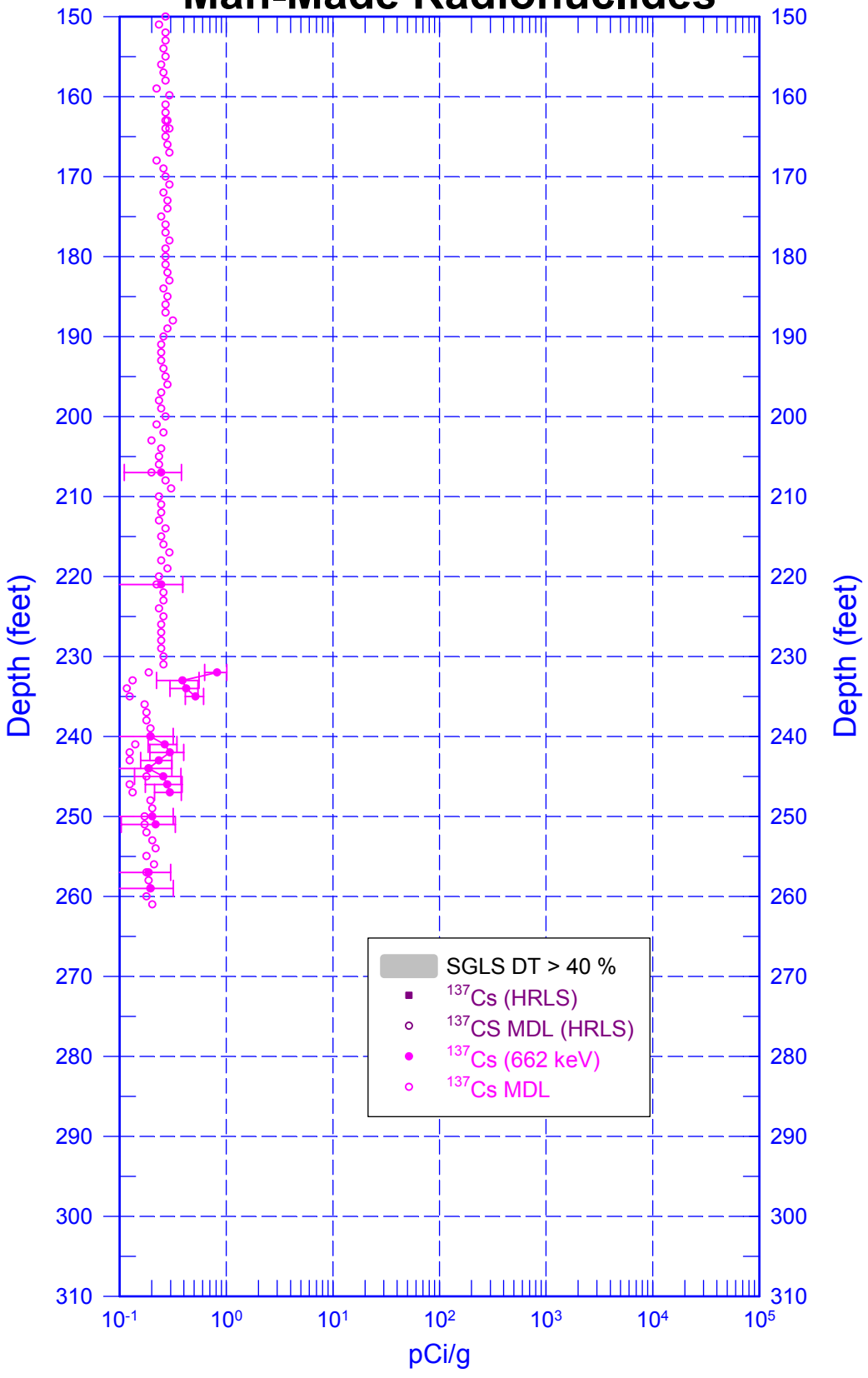


Date of Last Logging Run
4/16/2004

Zero Reference = Top of Casing

299-E25-5 (A6025)

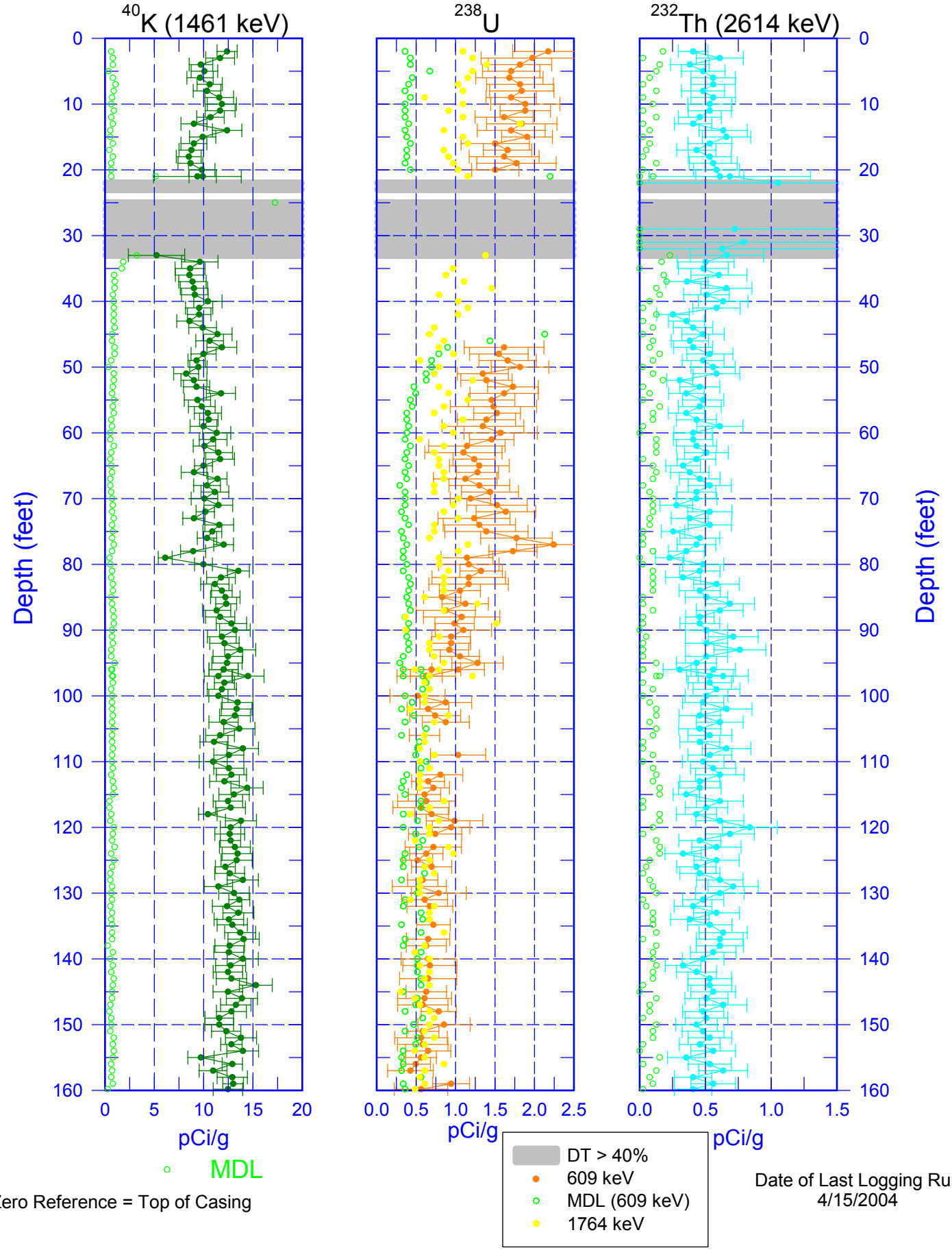
Man-Made Radionuclides



Date of Last Logging Run
4/16/2004

Zero Reference = Top of Casing

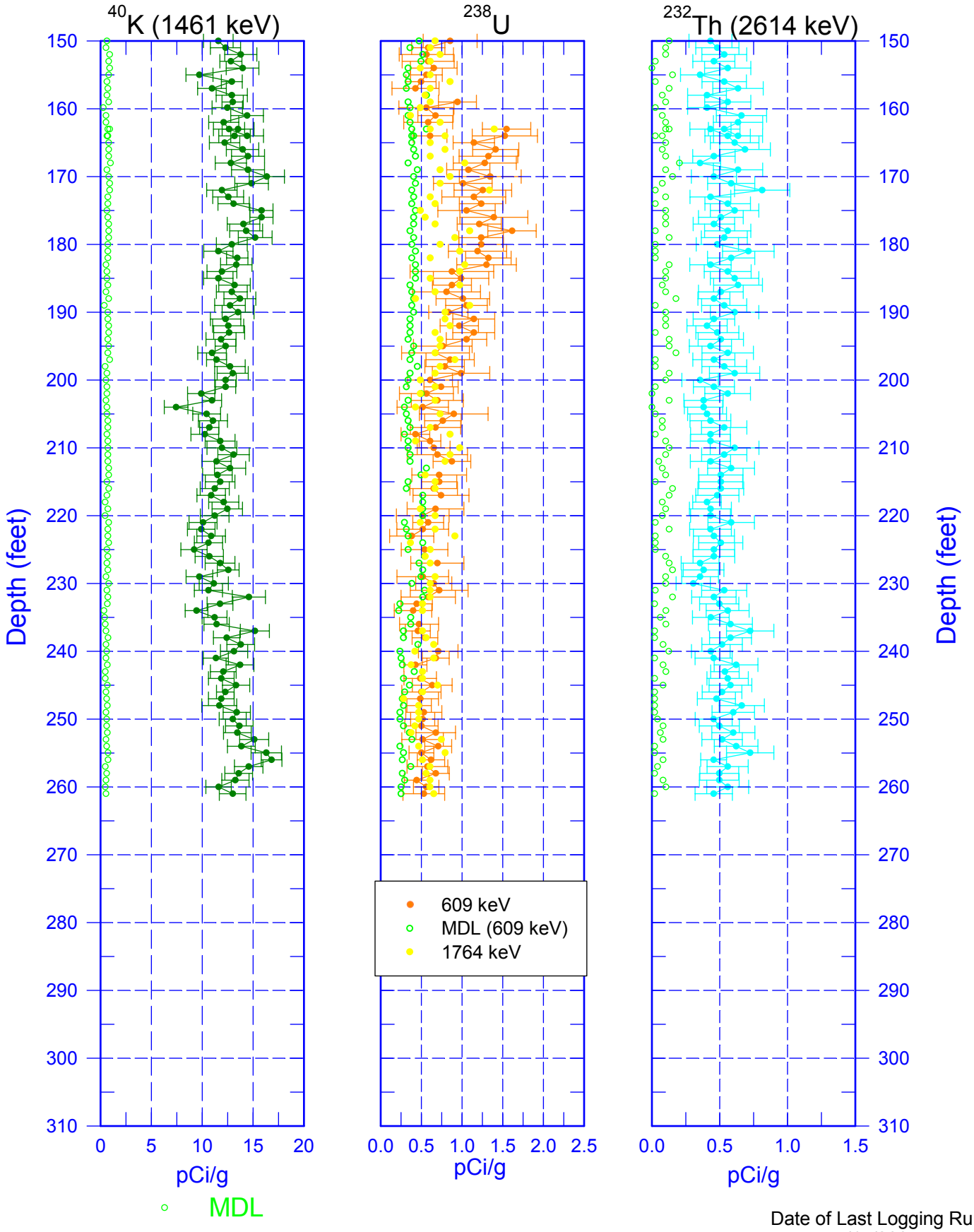
299-E25-5 (A6025)
Natural Gamma Logs



Zero Reference = Top of Casing

Date of Last Logging Run
4/15/2004

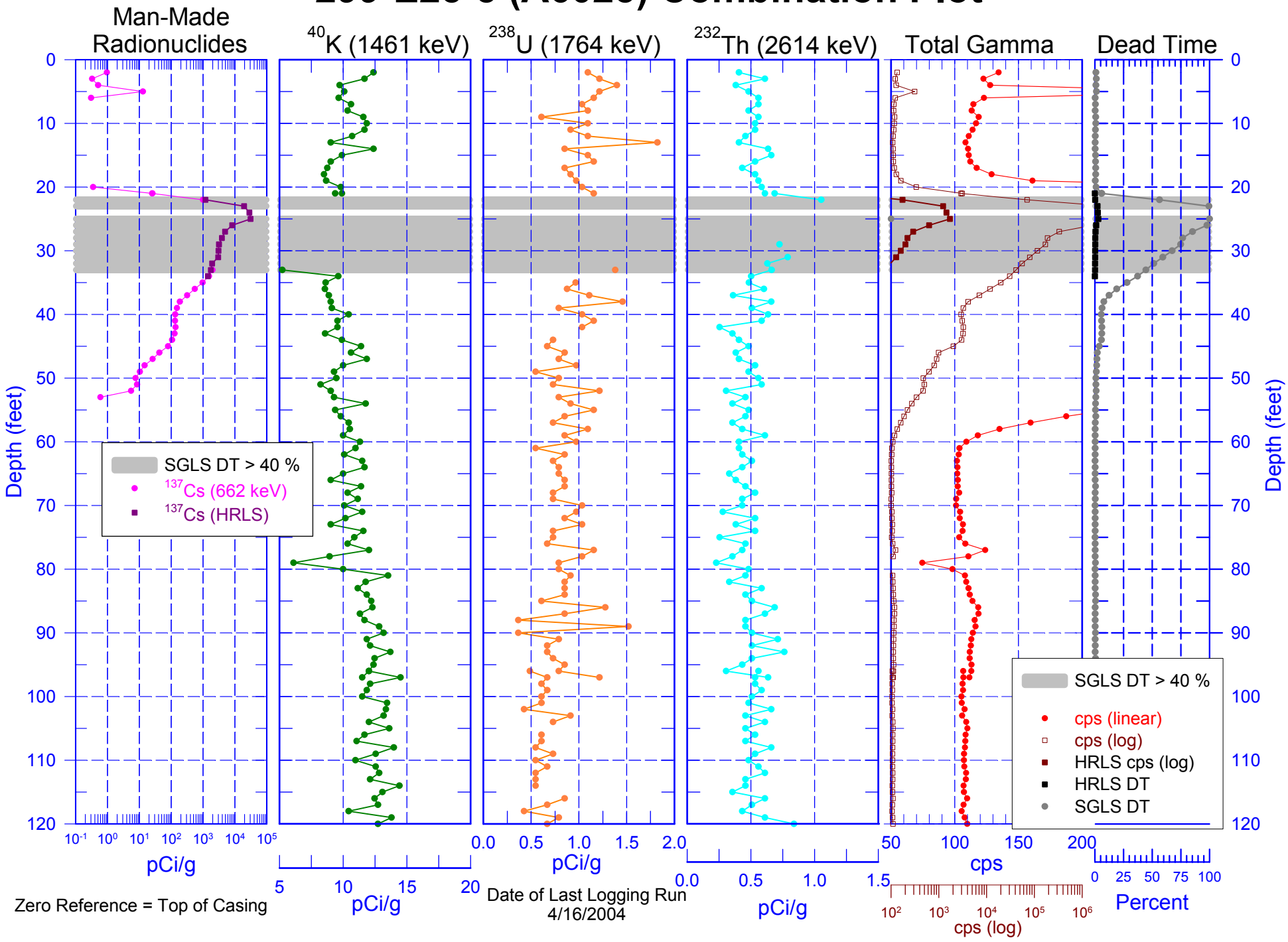
299-E25-5 (A6025)
Natural Gamma Logs



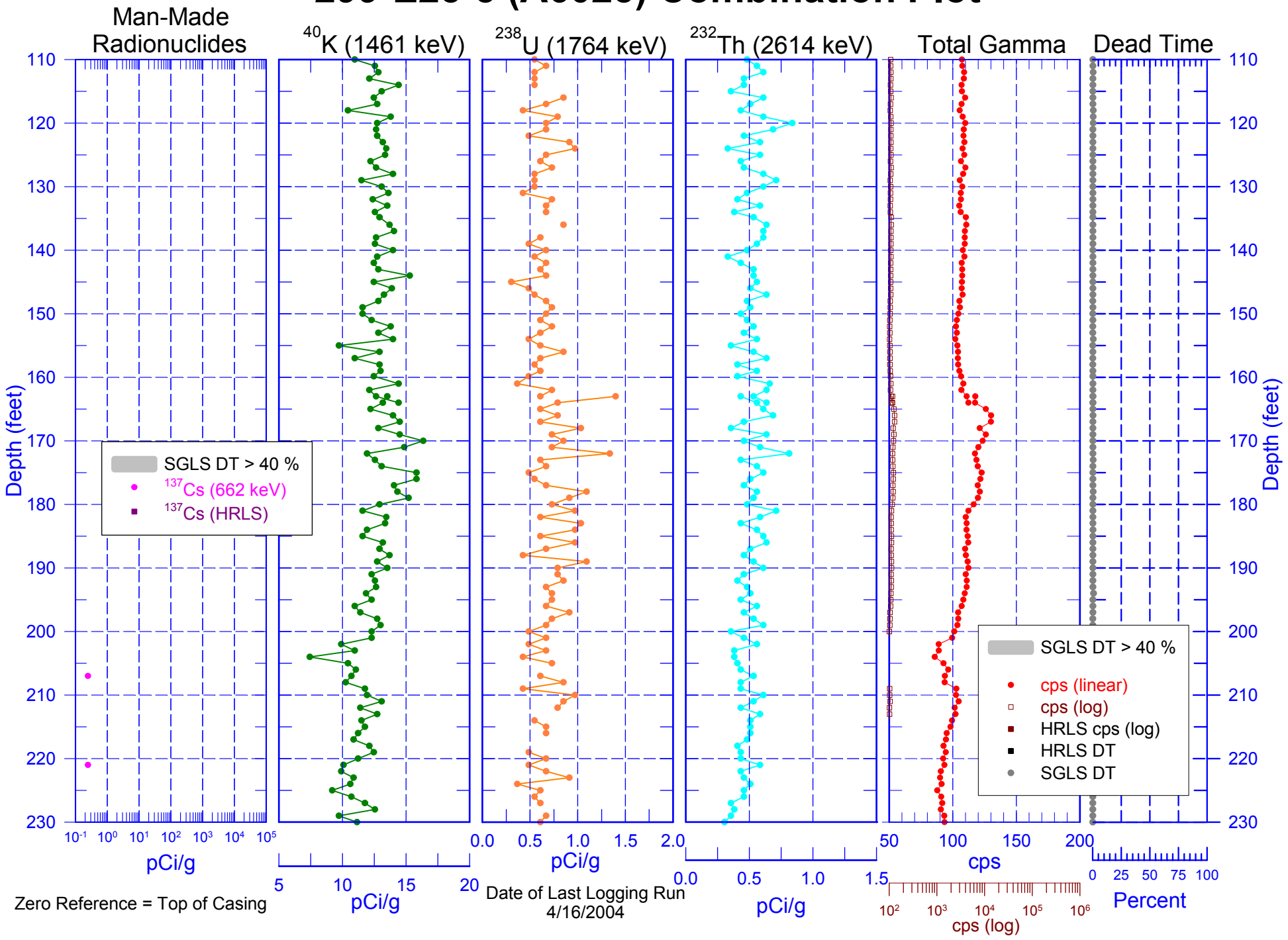
Zero Reference = Top of Casing

Date of Last Logging Run
4/15/2004

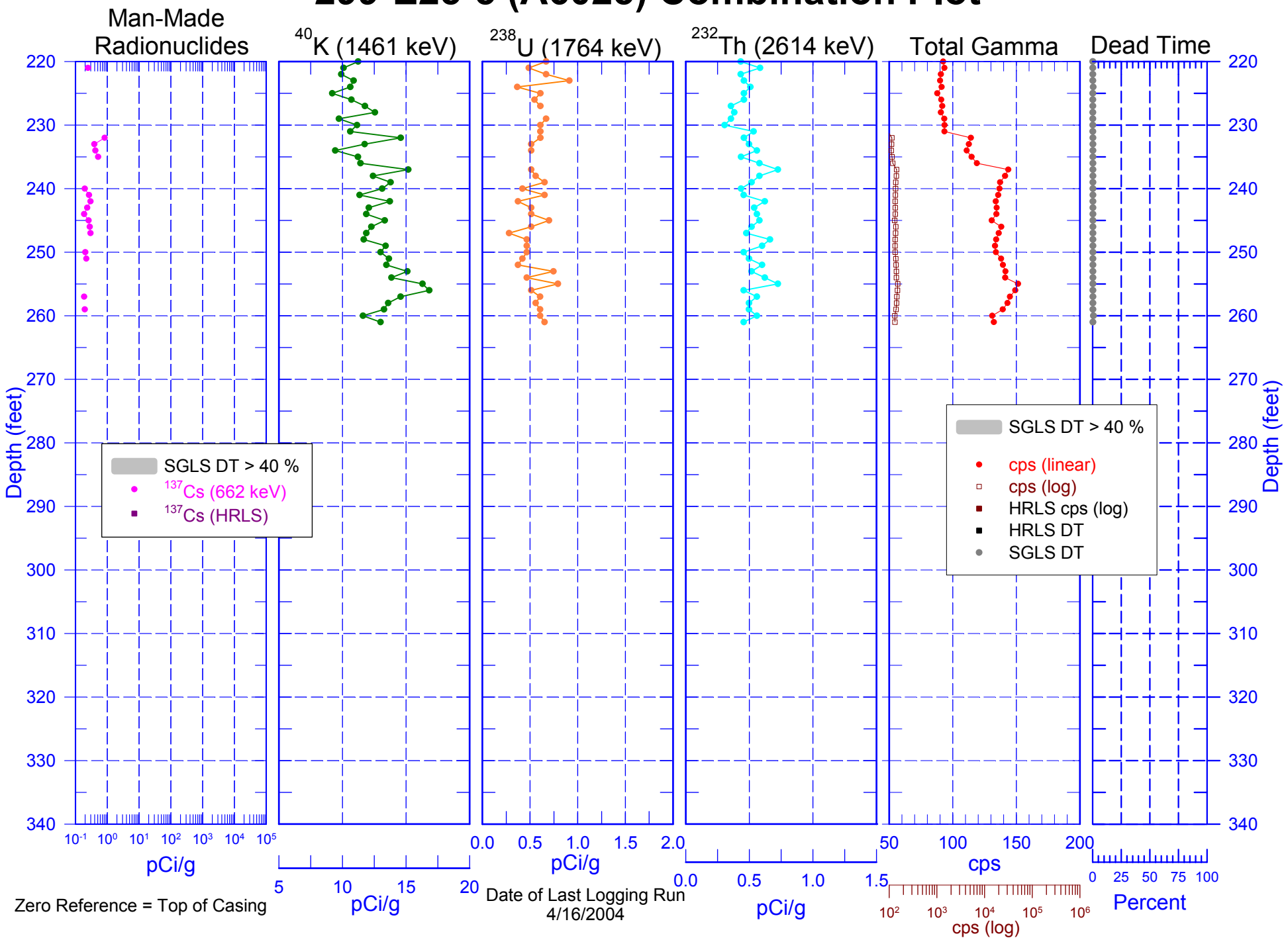
299-E25-5 (A6025) Combination Plot



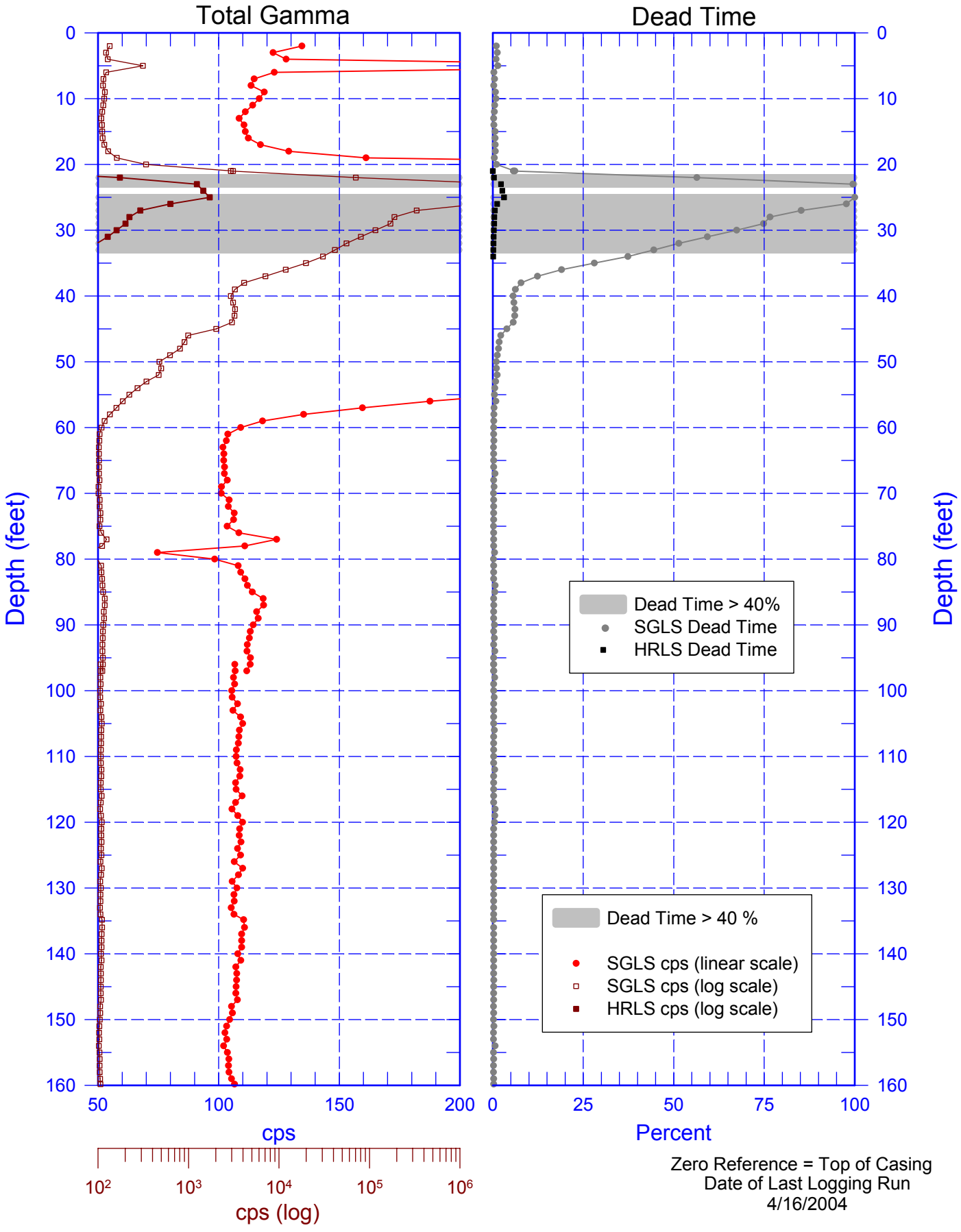
299-E25-5 (A6025) Combination Plot



299-E25-5 (A6025) Combination Plot

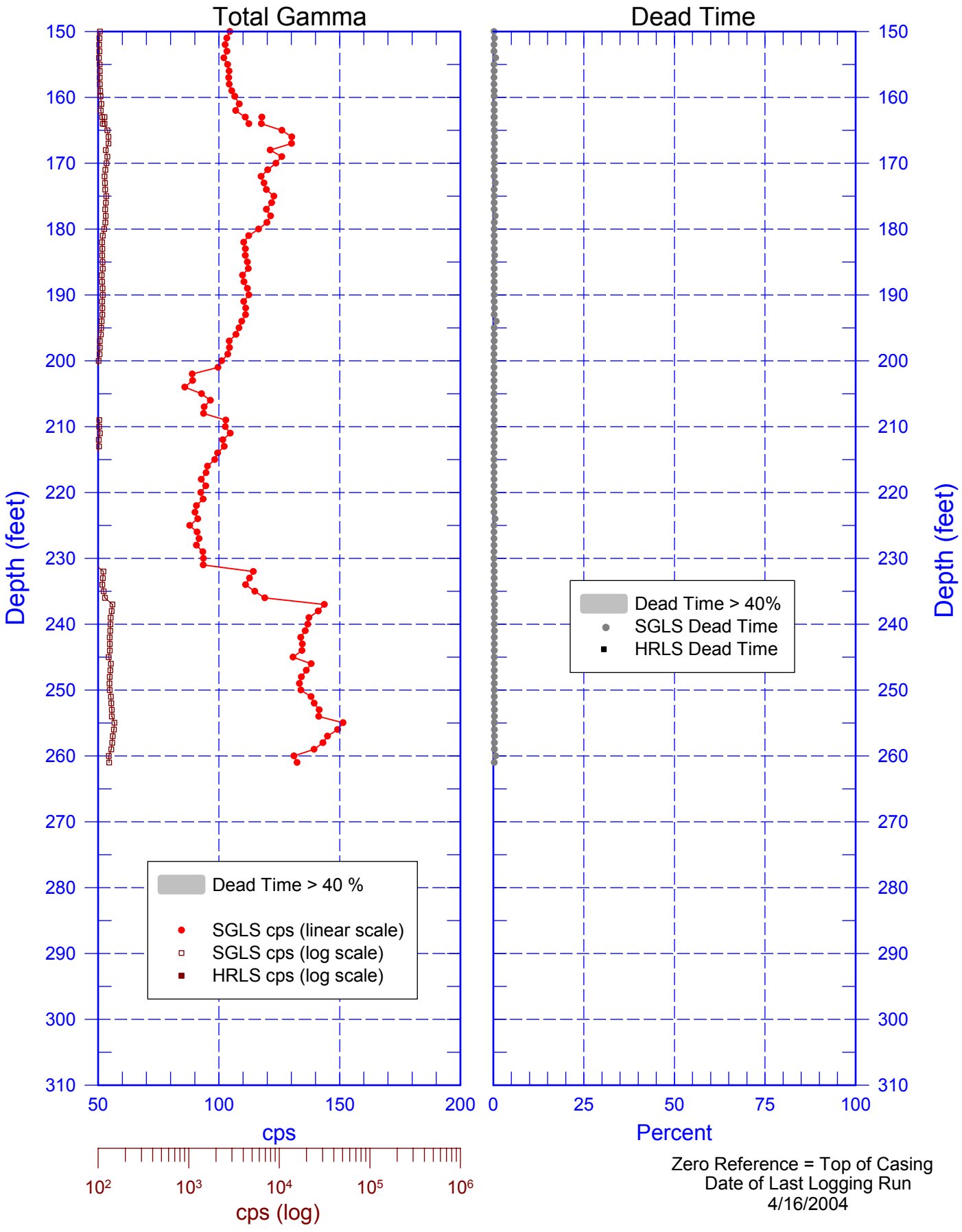


299-E25-5 (A6025)
Total Gamma & Dead Time



Zero Reference = Top of Casing
Date of Last Logging Run
4/16/2004

299-E25-5 (A6025)
Total Gamma & Dead Time

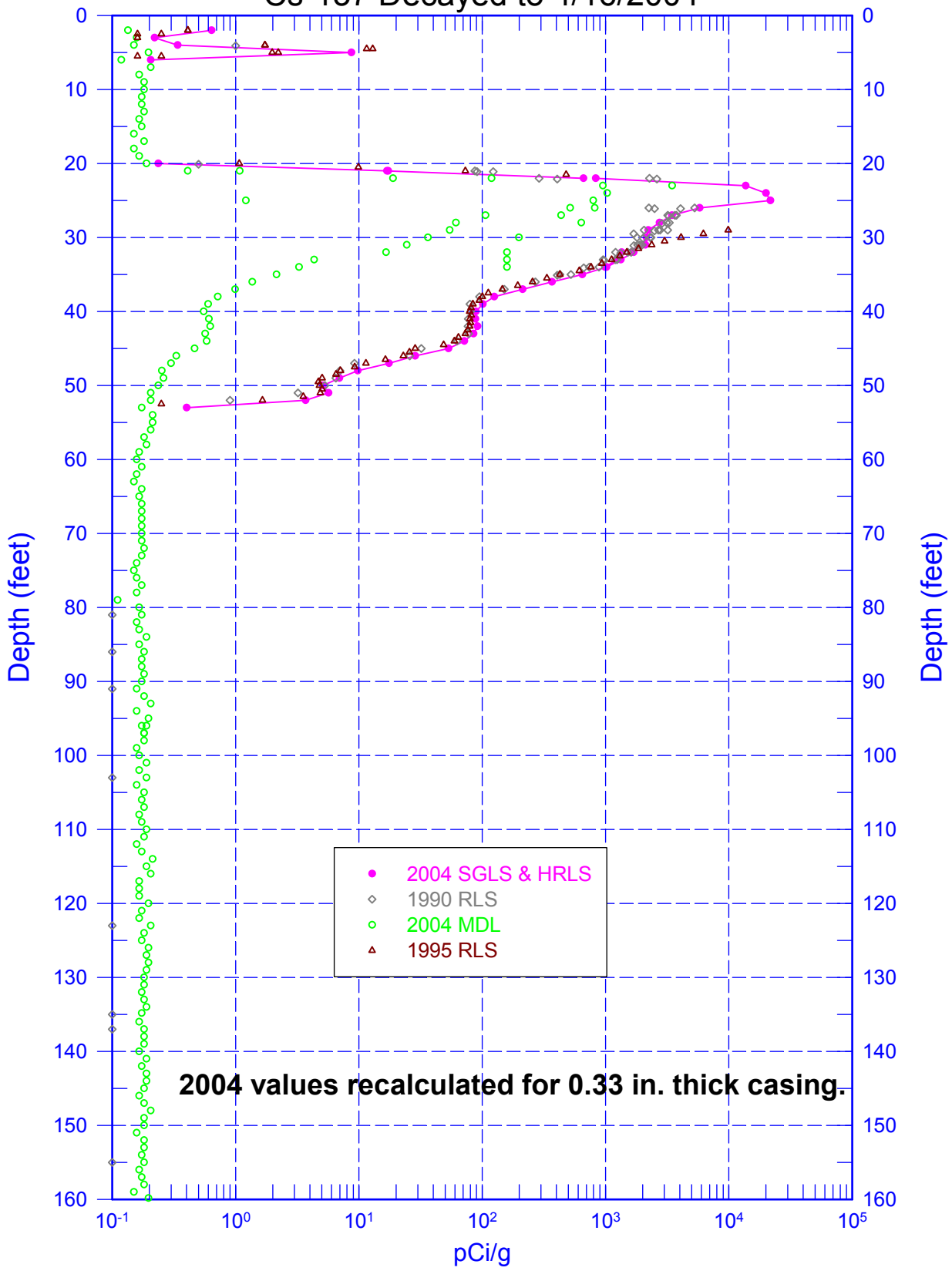


Zero Reference = Top of Casing
Date of Last Logging Run
4/16/2004

299-E25-5 (A6025)

RLS Data Compared to SGLS & HRLS Data

Cs-137 Decayed to 4/16/2004

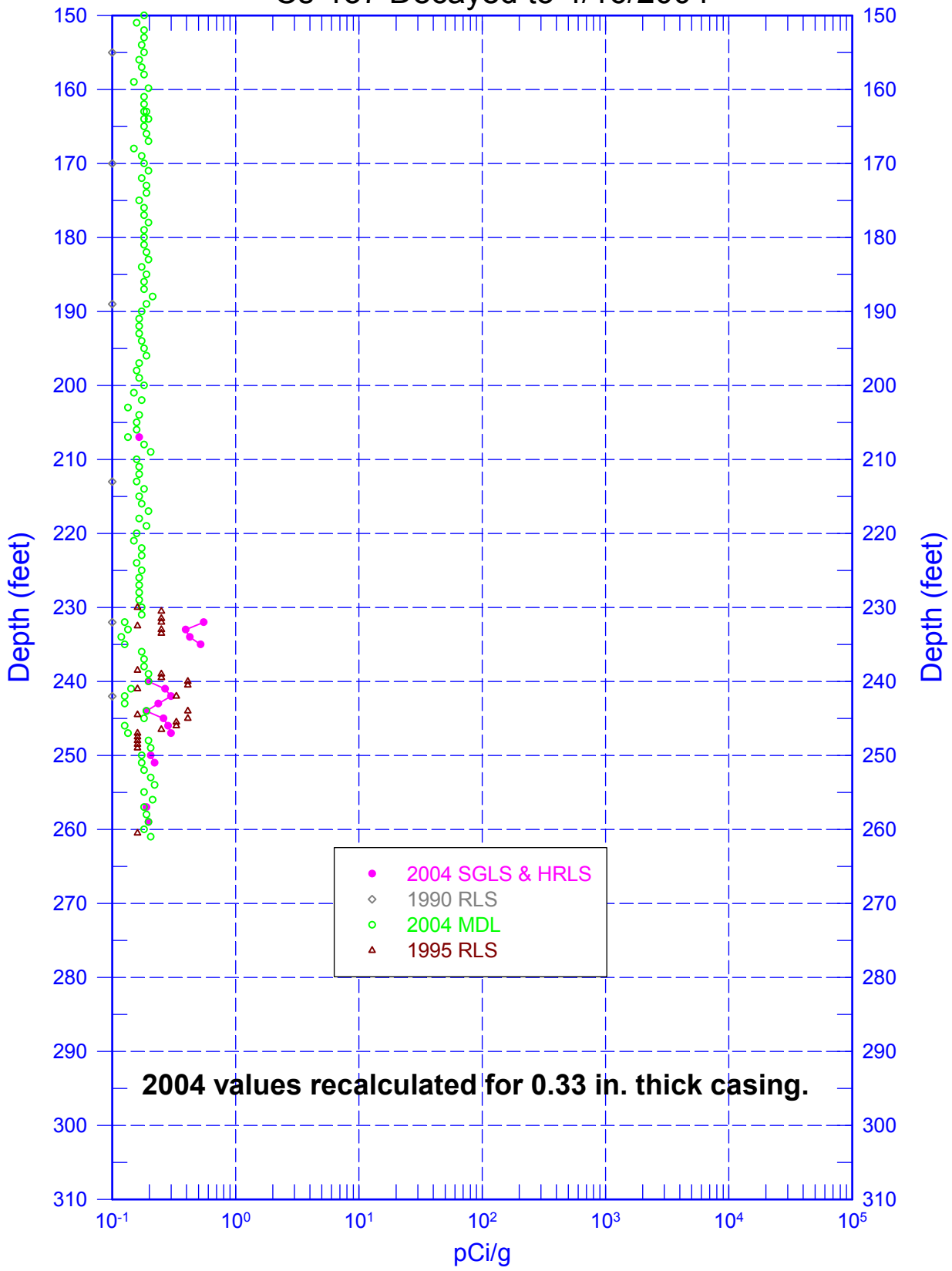


Zero Reference = Top of Casing

299-E25-5 (A6025)

RLS Data Compared to SGLS & HRLS Data

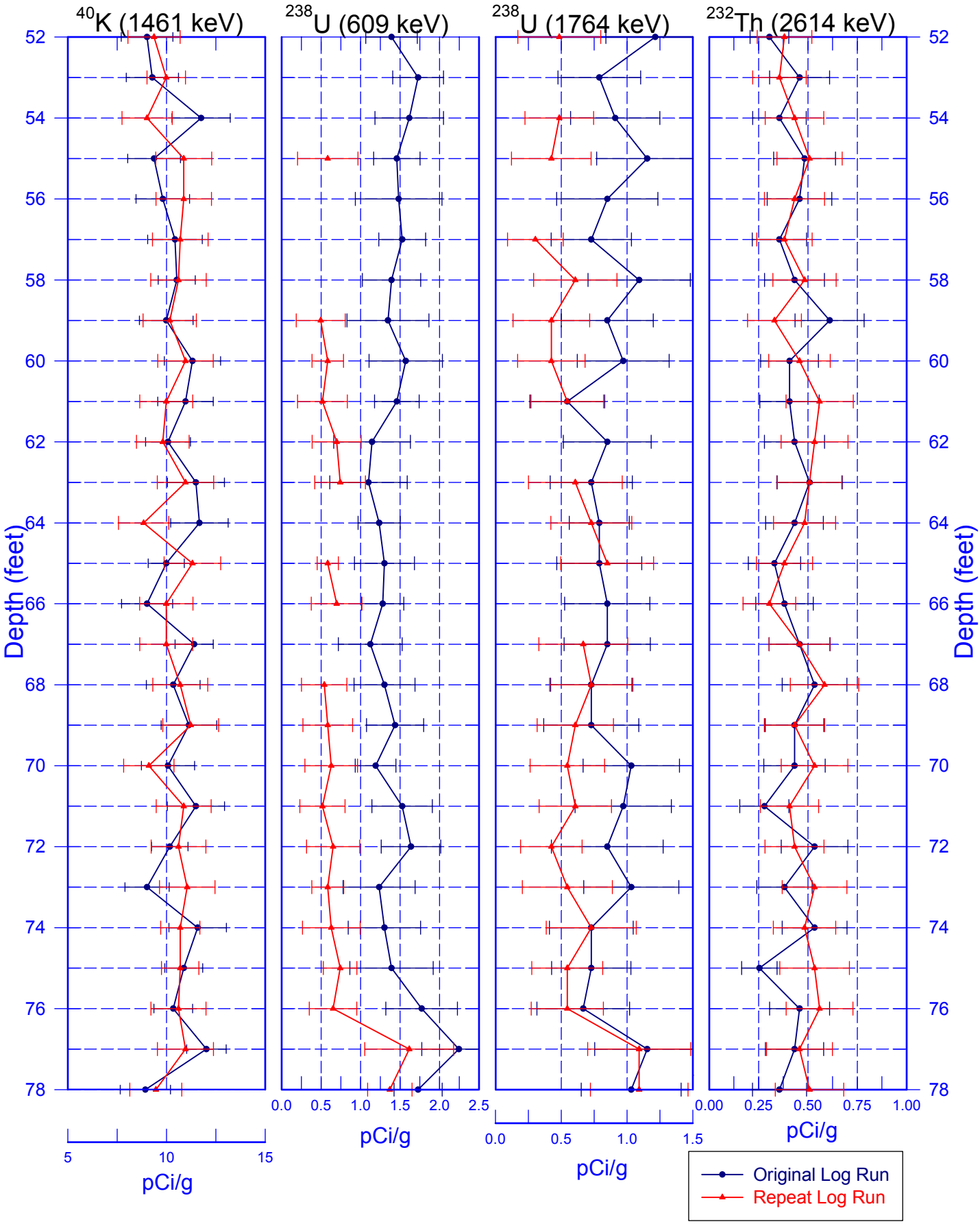
Cs-137 Decayed to 4/16/2004



Zero Reference = Top of Casing

299-E25-5 (A6025)

Rerun of Natural Gamma Logs (78.0 to 52.0 ft)



299-E25-5 (A6025)

Rerun of ^{137}Cs